
DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the exhaust air reflux equipment of a diesel power plant.
[0002]
[Description of the Prior Art] In order to control generating of NOx which is an injurious ingredient in exhaust gas, the so-called exhaust air reflux equipment which carries out recycling of the inactive exhaust gas to an inlet pipe is common knowledge. With this exhaust air reflux equipment, the maximum temperature at the time of combustion is lowered by opening the EGR path which returns a part of exhaust gas to an inlet pipe, and making inhalation air mix the exhaust gas of a constant rate (the amount of EGR(s)).
[0003] By the way, if an EGR rate (the amount of =EGRs / new-air-volume x100%) becomes large, the discharge concentration of a smoke will increase. For this reason, the swirl is strengthened with JP,60-162018,A according to an EGR rate becoming large.
[0004] If an EGR rate becomes large, this will be strengthening a swirl and improving the air at the time of combustion, and mixing of a fuel, and will reduce a smoke.
[0005]
[Problem(s) to be Solved by the Invention] However, if it is in the exhaust air reflux equipment of such a conventional diesel power plant, it is difficult to suppress increase of the smoke when making an EGR rate high sharply.
[0006] For example, if each concentration of NOx to an EGR rate and a smoke is shown in drawing 14 , smoked concentration will increase rapidly against NOx concentration decreasing sharply with the increment in an EGR rate. In this case, if swirl-ratio SR is enlarged, smoked concentration can be generally made small, but if it still becomes the high field of an EGR rate, it is over the threshold value of smoked concentration. Since the reduction effectiveness of the smoked concentration by the swirl is acquired by speeding up the air at the time of diffusive burning, and the diffusion rate of a fuel, if an oxygen density becomes the bottom of a low situation according to a high EGR rate, the effectiveness will not become not much large insufficient [the oxygen in air] more.
[0007] Moreover, NOx concentration is also large if swirl-ratio SR is enlarged.
[0008] Furthermore, if the amount of EGR(s) increases, carbon accumulates on an inhalation-of-air system, aggravation of the engine performance may be caused or the stick of an inlet valve etc. may arise.
[0009] This invention aims at reducing both NOx and a smoke, without increasing the amount of EGR (s) paying attention to the above-mentioned trouble.
[0010]
[Means for Solving the Problem] The inlet valve which invention according to claim 1 opens like the inhalation-of-air line in which a piston descends to the combustion chamber head-lining wall which forms a combustion chamber between the cavities which become depressed in the top face of a piston at

a concave, and introduces new mind into a combustion chamber, In the direct fuel-injection diesel engine equipped with the fuel injection valve which injects a fuel to a combustion chamber when a piston reaches near the top dead center, and the exhaust valve which opens like the exhaust air line in which a piston goes up, and discharges exhaust gas from a combustion chamber, respectively While equipping a combustion chamber head-lining wall with the EGR control valve which introduces a part of exhaust gas into a combustion chamber and having the good fluctuation valve system which adjusts the closing motion stage of an EGR control valve, it has the control means which makes an EGR control valve open the second half like an inhalation-of-air line according to an engine operation condition.
[0011] Invention according to claim 2 is equipped with the jet guide which projects from said combustion chamber head-lining wall, and forms in a jet guide jet guidance opening which collects the EGR gas introduced by said EGR control valve near said fuel injection valve.
[0012]
[Function] In invention according to claim 1, the EGR gas introduced in the gas column near the bottom dead point like an inhalation-of-air line is distributed over the upper part of a gas column in connection with a piston going up by the pressing operation by performing control which makes an EGR control valve open the second half like an inhalation-of-air line at the time of operation which performs exhaust air reflux.
[0013] If a piston reaches near the top dead center of a compression stroke, the EGR gas distributed over the upper part of a gas column will be extruded by the center section of the combustion chamber by being inserted between the top face of a piston, and a combustion chamber head-lining wall, and a squish will occur.
[0014] Thus, the fuel spray is distributed under the ambient atmosphere where EGR gas concentration is high, in a combustion chamber by countering the squish of the EGR gas extruded towards the center section of the combustion chamber, and injecting a fuel from a fuel injection valve.
[0015] The injected fuel lighting the bottom of the ambient atmosphere where EGR gas concentration is high, and mixing with inactive EGR gas, by performing initial combustion, the maximum temperature at the time of initial combustion is lowered, and the amount of generation of NOx is reduced sharply.
[0016] Thus, it becomes possible by stopping the amount of generation of NOx with little EGR gas to reduce an EGR rate sharply.
[0017] Mixing with the new mind which exists in a combustion chamber so much, by performing diffusive burning, oxidization of the carbon produced by initial combustion is promoted, and a particulate discharge is reduced at a combustion anaphase.
[0018] In invention according to claim 2, when a piston reaches near the top dead center of a compression stroke, by being inserted between the top face of a piston, and a combustion chamber head-lining wall, the squish of the EGR gas extruded by the center section of the combustion chamber is brought together in the direction of a fuel injection valve through jet guidance opening of a circular ring-like jet guide, and the influence of the EGR gas style which goes to a fuel injection valve is strengthened.
[0019] Thus, since the turbulence energy which mixes air with a fuel at the time of combustion increases while mixing of the fuel spray and inactive EGR gas is promoted further and has the amount of generation of NOx stopped by little EGR gas by countering in the style of [which are collected towards a fuel injection valve] EGR gas, and injecting a fuel from a fuel injection valve, the particulate amount of generation can be stopped.
[0020]
[Example] Hereafter, the example of this invention is explained based on an accompanying drawing.
[0021] In drawing 1 , the EGR manifold with which the inlet manifold to which a diesel-power-plant body and 6 distribute an inhalation-of-air path to each gas column, and, as for 7, 5 distributes inhalation of air, the exhaust manifold which collects the gas by which 9 is discharged from each gas column, and 8 distribute a flueway, the EGR path which flows back in each gas column in a part of exhaust gas (EGR gas) with which 4 is discharged from a flueway 8, and EGR gas, and 10 are fuel injection pumps which inject a fuel in each gas column synchronizing with engine rotation.

[0022] As shown in drawing 2 , a fuel injection valve 12 is formed in the center section of the combustion chamber head-lining wall 11 of each gas column, and an inlet valve 13, an exhaust valve 14, and the EGR control valve 15 are formed in the surroundings of a fuel injection valve 12, respectively. As shown in drawing 8 , the cavity 20 which becomes depressed in a concave was formed in the top face 18 of a piston 17, and the center section of the combustion chamber 19 formed by the cavity 20 is faced the fuel injection valve 12.
[0023] As shown in drawing 3 , an inlet valve 13 carries out closing motion actuation through a cam 16 synchronizing with engine rotation. Synchronizing with engine rotation, closing motion actuation is carried out through the cam which does not illustrate an exhaust valve 14, either. As shown in drawing 5 , while it crosses and opens like the exhaust air line in which a piston 17 goes up and an exhaust valve 14 discharges exhaust gas from a gas column to a flueway 8, like the inhalation-of-air line in which a piston 17 goes up, an inlet valve 13 goes across it, it opens it, and introduces the new mind from the inhalation-of-air path 6 into a gas column.
[0024] As shown in drawing 3 , the good fluctuation valve system 1 which makes adjustable the amount of valve lifts and valve-opening period of the EGR control valve 15 is formed. The hydraulic oil stored by the tank 21 is sucked up through an oil pump 22, and the hydraulic oil breathed out from an oil pump 22 is introduced into the oil pressure room 25 through an accumulator 23 and a solenoid valve 24.
[0025] While a solenoid valve 24 resists a valve spring 27, drops a plunger 26 and makes the EGR control valve 15 open by opening the oil pressure room 25 for free passage alternatively to the discharge side of an oil pump 22, and a tank 21 side based on the control signal from a control unit 2, and being open for free passage to the discharge side of an oil pump 22, by being open for free passage to a tank 21 side, it raises a plunger 26 according to the energization force of a valve spring 27, and carries out clausilium of the EGR control valve 15.
[0026] A control unit 2 opens and closes a solenoid valve 24 synchronizing with engine rotation, and as shown in drawing 4 , while it performs control which makes the EGR control valve 15 open in the anaphase like an inhalation-of-air line at the time of EGR which performs exhaust air reflux, as shown in drawing 5 , it performs control which suspends valve-opening actuation of the EGR control valve 15 at the time of operation which suspends exhaust air reflux.
[0027] As a signal representing an engine operation condition, a control unit 2 inputs engine-speed Ne and the accelerator opening Acc, performs control which makes the EGR control valve 15 open in the anaphase like an inhalation-of-air line, and as shown in drawing 7 , it performs control which increases an EGR rate according to engine generating torque falling according to an engine speed Ne falling. And a control unit 2 inputs each detecting signal of the cooling water temperature TW and a fuel temperature TF, and performs control which decreases a valve-opening period in the EGR control valve 15 according to the cooling water temperature TW and a fuel temperature TF falling.
[0028] Drawing 6 is a flow chart for controlling the closing motion stage of the EGR control valve 15, and is performed a fixed period.
[0029] First, engine-speed Ne, the accelerator opening Acc, the cooling water temperature TW, and a fuel temperature TF are read (step 1). In addition, an engine speed Ne is calculated from a reference pulse (one pulse per rotation of a jet pump 10), and a scale pulse (36 pulses per rotation of a jet pump 10). Each sensor which is not illustrated has detected the cooling water temperature TW and a fuel temperature TF.
[0030] A lookup is carried out, respectively from the read engine speed Ne, the basic valve-opening stage Tvo of the accelerator opening Acc to the solenoid valve 24, the basic clausilium stage Tvc, and each map, and it asks (step 2).
[0031] The map of the basic closing motion stages Tvo and Tvc is a map (not shown) which set the accelerator opening Acc and an engine speed Ne as a parameter that the EGR rate property of drawing 7 is acquired, and performs control which increases an EGR rate according to the accelerator opening Acc falling according to an engine speed Ne falling.
[0032] On the other hand, from a fuel temperature TF and the cooling water temperature TW, amount of closing motion stage amendments deltaTvc of a solenoid valve 24 is calculated, and the clausilium stage

Tvc of a solenoid valve 24 is amended by adding this at the basic clausilium stage Tvc (steps 3 and 4).
[0033] Amount of fuel-injection-timing amendments deltaTvc is the sum of amount of fuel temperature amendments deltaTvc1, and amount of water temperature amendments deltaTvc2. The clausilium stage Tvc of a solenoid valve 24 is brought forward, so that it becomes low temperature also in which property, and control which reduces an EGR rate is performed.
[0034] In this way, the valve-opening stage Tvo and the clausilium stage Tvc of the obtained solenoid valve 24 are stored in the predetermined address, and carry out the closing motion drive of the EGR control valve 15 by opening and closing a solenoid valve 24 with this valve-opening stage Tvo and the clausilium stage Tvc (steps 5 and 6).
[0035] It is constituted as mentioned above and an operation is explained below.
[0036] At the time of operation which performs exhaust air reflux, the EGR gas introduced in the gas column near the inhalation-of-air bottom dead point is distributed over the upper part of a gas column in connection with a piston 17 going up by a control unit's 2 opening and closing a solenoid valve 24 synchronizing with engine rotation, and performing control which makes the EGR control valve 15 open in the anaphase like an inhalation-of-air line.
[0037] If a piston 17 reaches near the top dead center of a compression stroke as shown in drawing 8, the squish which is the gas stream extruded by the center section of the combustion chamber 19 as the drawing Nakaya mark shows the EGR gas distributed over the upper part of a gas column by being inserted between the top face 18 of a piston 17 and the combustion chamber head-lining wall 11 will occur.
[0038] Thus, the fuel spray is distributed under the ambient atmosphere where EGR gas concentration is high, in a combustion chamber 19 by countering the squish of the EGR gas extruded towards the center section of the combustion chamber 19, and injecting a fuel from a fuel injection valve 12.
[0039] The injected fuel lighting the bottom of the ambient atmosphere where EGR gas concentration is high, and mixing with inactive EGR gas, by performing initial combustion, the maximum temperature at the time of initial combustion falls, and the amount of generation of NOx is reduced sharply.
[0040] Thus, it becomes possible by stopping the amount of generation of NOx at the time of initial combustion with little EGR gas to reduce an EGR rate 50 to 60%, as shown in drawing 7 compared with the example of control in equipment (drawing 9) conventionally which is introduced into a gas column from an inhalation-of-air path, mixing EGR gas with new mind.
[0041] Mixing with the new mind which exists so much in a combustion chamber 19, by performing diffusive burning, oxidization of the carbon produced by initial combustion is promoted, and a particulate discharge is reduced at a combustion anaphase.
[0042] Next, other examples shown in drawing 10 make the jet guide 31 which brings a squish together in a fuel injection valve 12 project from the combustion chamber head-lining wall 11. In addition, it explains to the corresponding point of drawing 1 -3 using the same sign.
[0043] As shown also in drawing 12 and 13, the circular ring-like jet guide 31 is concluded by the combustion chamber head-lining wall 11 through four bolts 34, and is projected and prepared from the plane combustion chamber head-lining wall 11.
[0044] It has four jet guidance openings 33 to the circular ring-like jet guide 31, and the cross section of each jet guidance opening 33 is formed so that it may reduce gradually towards a fuel injection valve 12. Thereby, the squishes which pass the jet guidance opening 33 are collected towards a fuel injection valve 12.
[0045] From the inferior surface of tongue 36, to the combustion chamber head-lining wall 11, the top face 35 of each jet guidance opening 33 inclined greatly, and was formed, the combustion chamber 19 was turned caudad and the squish which passes the jet guidance opening 33 has come it.
[0046] It is constituted as mentioned above and an operation is explained below.
[0047] At the time of operation which performs exhaust air reflux, the EGR gas introduced in the gas column near the bottom dead point like an inhalation-of-air line is distributed over the upper part of a gas column in connection with a piston 17 going up by a control unit's 2 opening and closing a solenoid valve 24 synchronizing with engine rotation, and performing control which makes the EGR control

valve 15 open the second half like an inhalation-of-air line.
[0048] If a piston 17 reaches near the top dead center of a compression stroke as shown in drawing 11 , the squish extruded by the center section of the combustion chamber 19 as the drawing Nakaya mark shows the EGR gas distributed over the upper part of a gas column by being inserted between the top face 18 of a piston 17 and the combustion chamber head-lining wall 11 will occur.
[0049] When the squish of this EGR gas passes each jet guidance opening 33 of the circular ring-like jet guide 31, the influence which goes to a fuel injection valve 12 is strengthened.
[0050] Thus, the fuel spray is distributed under the ambient atmosphere where EGR gas concentration is high, in a combustion chamber 19 by countering in the style of [which are collected towards a fuel injection valve 12] EGR gas, and injecting a fuel from a fuel injection valve 12.
[0051] The injected fuel lighting the bottom of the ambient atmosphere where EGR gas concentration is high, and mixing with inactive EGR gas, by performing initial combustion, the maximum temperature at the time of initial combustion is lowered, and the amount of generation of NOx is reduced sharply.
[0052] Since the turbulence energy which mixes air with a fuel at the time of combustion increases while mixing of the fuel spray and inactive EGR gas is promoted further and has the amount of generation of NOx stopped by little EGR gas by strengthening the jet of the EGR gas which goes to a fuel injection valve 12 through the jet guide 31, the amount of generation of carbon can be stopped.
[0053] Mixing with the new mind which exists so much in a combustion chamber 19, by performing diffusive burning, oxidization of the carbon produced by initial combustion is promoted, and a particulate discharge is reduced at a combustion anaphase.
[0054]
[Effect of the Invention] The inlet valve which invention according to claim 1 opens like the inhalation-of-air line in which a piston descends to the combustion chamber head-lining wall which forms a combustion chamber between the cavities which become depressed in the top face of a piston at a concave, and introduces new mind into a combustion chamber as explained above, In the direct fuel-injection diesel engine equipped with the fuel injection valve which injects a fuel to a combustion chamber when a piston reaches near the top dead center, and the exhaust valve which opens like the exhaust air line in which a piston goes up, and discharges exhaust gas from a combustion chamber, respectively While equipping a combustion chamber head-lining wall with the EGR control valve which introduces a part of exhaust gas into a combustion chamber and having the good fluctuation valve system which adjusts the closing motion stage of an EGR control valve Both NOx and a smoke can be reduced without raising the EGR gas concentration of the field where the fuel spray is injected in a combustion chamber, and increasing the amount of EGR(s), since it had the control means which makes an EGR control valve open the second half like an inhalation-of-air line according to an engine operation condition.
[0055] Invention according to claim 2 is equipped with the jet guide which projects from said combustion chamber head-lining wall, since it formed in the jet guide jet guidance opening which collects the EGR gas introduced by said EGR control valve near said fuel injection valve, can strengthen a flow of the EGR gas of the field where the fuel spray is injected in a combustion chamber, and can suppress generating of a smoke effectively.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The inlet valve which opens like the inhalation-of-air line in which a piston descends to the combustion chamber head-lining wall which forms a combustion chamber between the cavities which become depressed in the top face of a piston at a concave, and introduces new mind into a combustion chamber, In the direct fuel-injection diesel engine equipped with the fuel injection valve which injects a fuel to a combustion chamber when a piston reaches near the top dead center, and the exhaust valve which opens like the exhaust air line in which a piston goes up, and discharges exhaust gas from a combustion chamber, respectively While equipping a combustion chamber head-lining wall with the EGR control valve which introduces a part of exhaust gas into a combustion chamber and having the good fluctuation valve system which adjusts the closing motion stage of an EGR control valve Exhaust air reflux equipment of the diesel power plant which is equipped with the control means which makes an EGR control valve open the second half like an inhalation-of-air line according to an engine operation condition, and is characterized by things.
[Claim 2] Exhaust air reflux equipment of the diesel power plant according to claim 1 characterized by forming in said jet guide jet guidance opening which collects the EGR gas which was equipped with the jet guide which projects from said combustion chamber head-lining wall, and was introduced by said EGR control valve near said fuel injection valve.

[Translation done.]